



Newly recorded and rare Desmidiiales (Charophyta: Conjugatophyceae) from the Middle Urals, Russia

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Abstract: New distributional data on 14 previously unrecorded or rare species and varieties of algae belonging to Closteriaceae, Desmidiaceae, Gonatozygaceae and Peniaceae (order Desmidiiales) are presented for the Middle Urals. *Closterium cornu* Ehrenberg ex Ralfs, *Closterium macilentum* Brébisson, *Closterium navicula* (Brébisson) Lütkenmüller, and *Cosmarium crenulatum* Nägeli are newly recorded to the Urals. A brief description, including measurements of cells as well as regional and global distribution, is given for each taxon.

Key words: green algae; new records; eutrophic swamps; Chelyabinsk region

Since the 1920s, research into the algal flora of the Urals has accumulated a substantial body of data on the biodiversity of various groups of algae, including Conjugatophyceae. The most thorough studies were carried out in the Polar, Subpolar, and the Southern Urals (Voronikhin 1930; Snitko and Sergeeva 2003; Yarushina et al. 2004; Patova and Demina 2008; Sterlyagova 2008; Snitko 2009). In the present paper, new records of Desmidiiales are presented and expand sparsely available data (Yarushina et al. 2003; Butakova and Stanislavskaya 2004; Belyaeva and Pozdeev 2005; Shakhmatov 2014, 2015) on distribution of conjugates in the Middle Urals.

Samples were collected during the spring and summer of 2013 to 2015 at four lakes, Bolshoye Yamskoe (56°08'33.7" N, 060°53'25.1" E), Karaguz (56°06'16.6" N, 060°52'37.1" E) Travyanoye (56°06'59.7" N, 060°55'28.1" E) and Cherkaskul (56°10'34.4" N, 060°50'56.8" E). These lakes are located in the northern part of Chelyabinsk region (Russian Federation) in the pine–birch forest subzone of the boreal coniferous forest zone of the Middle Urals eastern macroslope (Figure 1) (Kulikov 2005; Chibilyov and Chibilyov 2012). The sampled lakes are transforming into eutrophic sedge–reed swamps. Their margins are covered by vast peat deposits with

typical flora, including *Alisma plantago-aquatica* L., *Calla palustris* L., *Carex vesicaria* L., *Comarum palustre* L., *Cicuta virosa* L., *Eleocharis palustris* (L.) Roem. et Schult, *Equisetum fluviatile* L., *Phragmites australis* (Cav.) Trin. ex Steud., *Stratiotes aloides* L., *Typha latifolia* L., and *Utricularia intermedia* Hayne. Samples were taken mostly in hollows among the thicket of macrophytes, where the most favorable conditions for development of conjugates are created (Brook 1981). Samples were collected by filtering through a plankton net (Sadchikov 2003).

The samples were studied under a light microscope (Levenhuk 320). Species were identified using keys on Conjugatophyceae (Kossinskaya 1952, 1960; Palamar-Mordvintseva 1982; Coesel and Meesters 2007) and verified by Dr. A. F. Luknitskaya (V. L. Komarov Botanical Institute of the Russian Academy of Sciences). Validity of taxa and general distribution were checked in AlgaeBase (Guiry and Guiry 2016). Photographs of algae were taken with a Levenhuk C310 NG digital camera. The photos were deposited in the herbarium of the Ural Federal University (UFU A 91 to 112).

One rare and 13 previously unrecorded species or varieties of Desmidiiales were identified from the Middle Urals in the present study. They belong to Closteriaceae (4), Desmidiaceae (8), Gonatozygaceae (1), and Peniaceae (1) (order Desmidiiales). Four species are newly recorded to the Urals in general. A list of species with brief description of the taxa, as well as their distribution in the Urals and globally, is given below.

Closterium acutum* var. *linea (Perty) West & G.S. West, 1900
Figure 2

A single record in Travyanoye lake (UFU A 100). Cells fusiform, straight, 158.4 µm long and 6.2 µm wide. Ends acuminate, apical vacuoles contain few small crystals of gypsum. The species has been previously known from the Southern (Snitko and Sergeeva 2003; Yarushina et al. 2004; Snitko 2009) and Polar Urals (Voronikhin 1930).

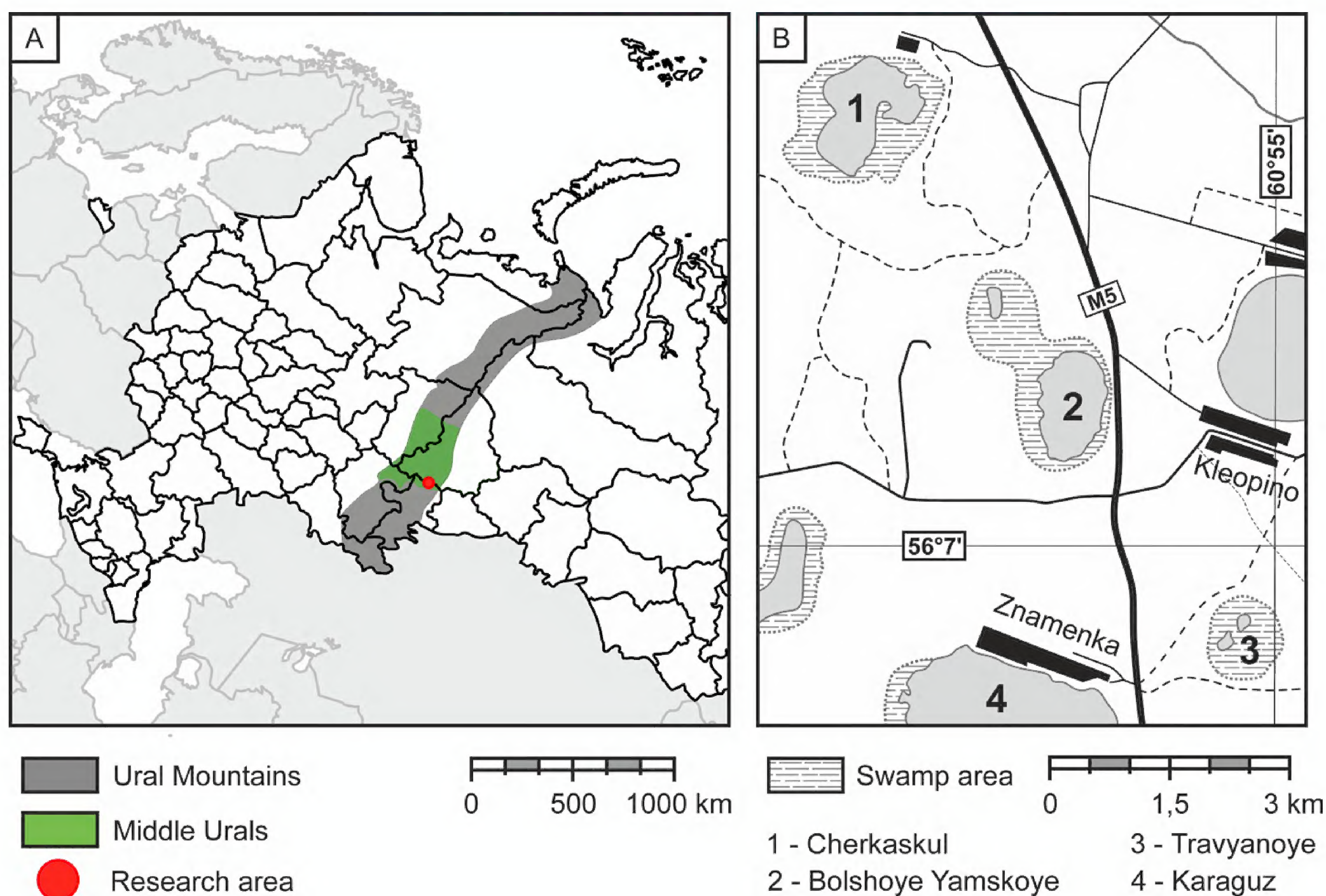


Figure 1. Location of research area (B) in the Ural Mountains (A).

Distribution: Europe, Asia, Africa, Australia, North America, South America.

Closterium cornu Ehrenberg ex Ralfs, 1848

Figure 3

The species is found in small quantities in the Travyanoye lake (UFU A 101). Cells fusiform, almost straight or slightly curved, 148.3–155.4 μm long and 9.2–9.5 μm wide. Ends obtuse, apical vacuoles contain one large crystal of gypsum each. The species is newly recorded from the Urals.

Distribution: Europe, Asia, Africa, Australia, North America, South America, New Zealand, Polynesia, Java.

Closterium macilentum Brébisson, 1856

Figure 4

The species is found in a small number in the Travyanoye (UFU A 102) and Cherkaskul (UFU A 108) lakes. Cells fusiform, straight, slightly curved at the ends, 186.9–258.9 μm long and 8.7–11.7 μm wide. The species can be confused with *Closterium cornu* Ehrenberg ex Ralfs, from which it differs by a larger size, a frequent formation of girdle bands, as well as the presence of few small crystals of gypsum in the apical vacuoles. The species is newly recorded from the Urals.

Distribution: Europe, Asia, Greenland, Australia, North America, South America, Caribbean Islands, Pacific Islands, Faroe Islands, Madagascar, Java.

Closterium navicula (Brébisson) Lütkenmüller, 1905

Figure 5

A single record in the Cherkaskul lake (UFU A 106). Cells straight, fusiform, 70.3 μm long and 15.9 μm wide. Ends widely rounded, apical vacuoles contain one large crystal of gypsum. The species is newly recorded from the Urals.

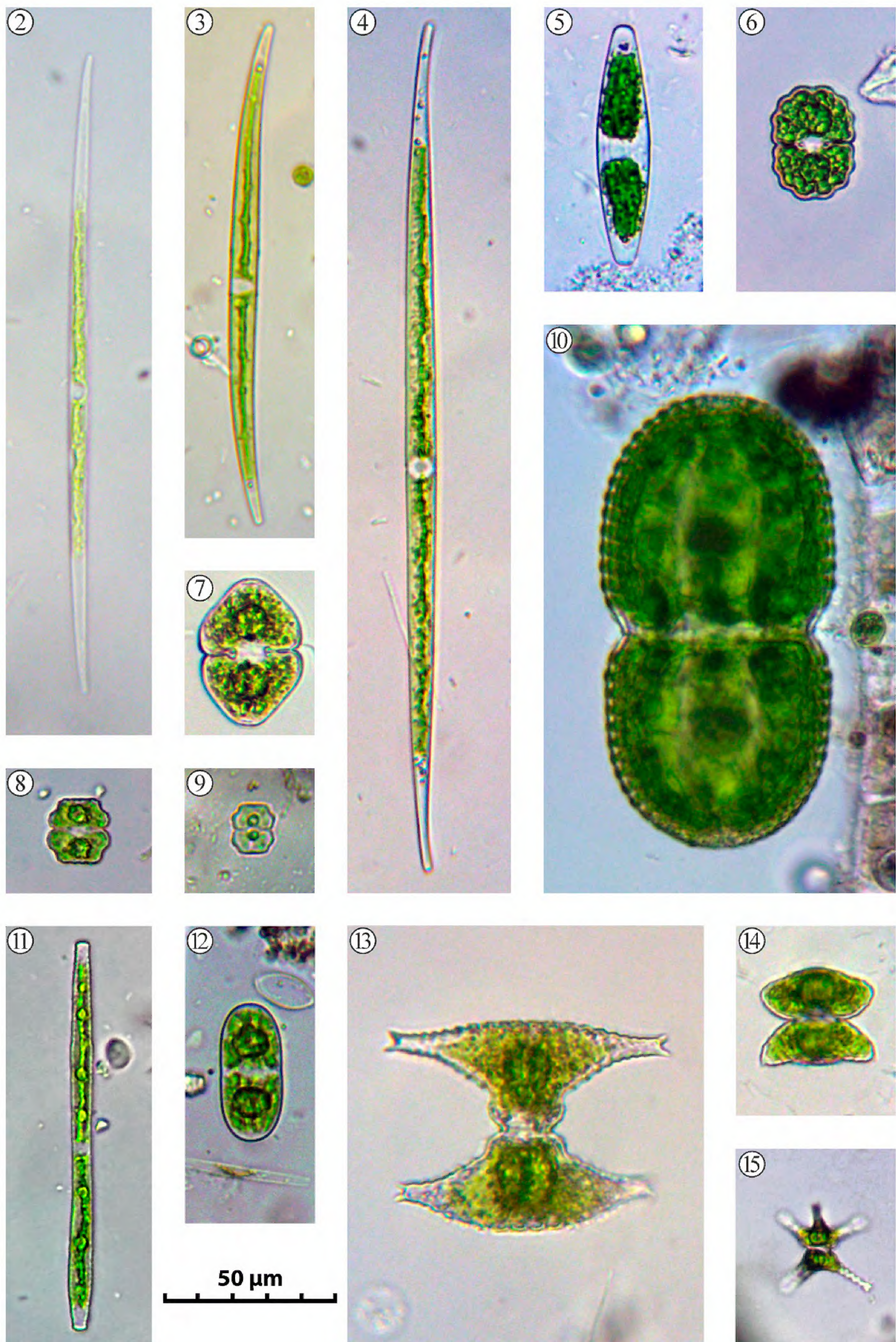
Distribution: Europe, Asia, Greenland, Faroe Islands, Africa, Australia, New Zealand, North America, South America, Java.

Cosmarium crenulatum Nägeli, 1849

Figure 6.

The species is found in a small number in the Bolshoye Yamskoye (UFU A 94) and Cherkaskul (UFU A 107) lakes. Cells are oval in general outline, 24.9–32.3 μm long and 18.4–23.8 μm wide. Semicells with smooth, undulating cell wall. Sinus narrow-linear, isthmus 6.2–6.6 μm wide. The species is new to the Urals.

Distribution: Europe, Asia, Australia, New Zealand, South America.



Figures 2–15. Newly recorded and rare desmids for Middle Urals. **2.** *Closterium acutum* var. *linea* (UFU A 100). **3.** *Closterium cornu* (UFU A 101). **4.** *Closterium macilentum* (UFU A 108). **5.** *Closterium navicula* (UFU A 106). **6.** *Cosmarium crenulatum* (UFU A 94). **7.** *Cosmarium granatum* (UFU A 110). **8.** *Cosmarium humile* (UFU A 104). **9.** *Cosmarium regnellii* (UFU A 109). **10.** *Cosmarium striolatum* (UFU A 91). **11.** *Gonatozygon brebissonii* (UFU A 97). **12.** *Penium polymorphum* (UFU A 98). **13.** *Staurostrum bicornu* (UFU A 111). **14.** *Staurostrum lunatum* (UFU A 112). **15.** *Staurostrum paradoxum* (UFU A 99).

Cosmarium granatum Brébisson ex Ralfs, 1848

Figure 7

The species is found in a large number in the the Bolshoye Yamskoye (UFU A 95) and Cherkaskul (UFU A 96, 110) lakes. Cells rhomboid in general outline, 36.8–42.5 µm long and 24.2–29.4 µm wide. Cell wall punctured. Sinus narrow-linear, isthmus 6.1–9.7 µm wide. The species has been known from the South (Snitko and Sergeeva 2003; Yarushina et al 2004), Subpolar (Sterlyagova 2008), Polar (Patova and Demina 2008) Urals and from the western foothills of the Middle Urals (Belyaeva 2004).

Distribution: Europe, Asia, Australia, New Zealand, North America, South America.

Cosmarium humile Nordstedt ex De Toni, 1889

Figure 8.

The species is found in a small number in the Karaguz (UFU A 103), Travyanoye (UFU A 104) and Cherkaskul (UFU A 92) lakes. Cells are octagonal in general outline, 18.1–22.2 µm long and 17.4–20.2 µm wide. Semicells trapezoidal with concave sides and slightly undulate flat tops. Cell wall smooth. Sinus narrow-linear, isthmus 4.4–6.7 µm wide. The species has been previously known from the Southern Urals (Snitko and Sergeeva 2003; Yarushina et al 2004).

Distribution: Europe, Asia, Australia, North America, South America.

Cosmarium regnellii Wille, 1884

Figure 9

The species is found in a large number at the lakes Bolshoye Yamskoe (UFU A 93), Travyanoye (UFU A 105) and Cherkaskul (UFU A 109). Cells are octagonal in general outline, 12.6–17.2 µm long and 10.1–13.6 µm wide. Semicells hexagonal. Sinus narrow-linear, an isthmus 3.5–3.7 µm wide. The species has been previously known from the Subpolar (Sterlyagova 2008) and Polar (Patova and Demina 2008) Urals.

Distribution: Arctic, Europe, Asia, Australia, New Zealand, North America, South America.

Cosmarium striolatum (Nägeli) W.Archer, 1861

Figure 10.

A single record in the Cherkaskul lake (UFU A 91). Cells oval in general outline, 132.6 µm long and 68.5 µm wide. Sinus wide open, shallow, isthmus of 55.3 µm wide. Cell wall covered by large granules, placed in diagonal rows. This is a very rare species, previously known in the Middle Urals only from the Boevskoye lake (Shakhmatov 2015).

Distribution: Europe, Asia, North America.

Gonatozygon brebissonii De Bary, 1858

Figure 11

A single record in the Cherkaskul lake (UFU A 97). Cells cylindrical, elongated, 114 µm long and 5.5 µm

wide. Ends truncate, capitate. Cell wall covered by small spines. The species was previously known from the Southern Urals (Yarushina et al 2004).

Distribution: Arctic, Europe, Asia, Australia, New Zealand, North America, South America.

Penium polymorphum (Perty) Perty, 1852

Figure 12

A single record in the Cherkaskul lake (UFU A 98). Cells elliptical with a slight constriction, 40.5 µm long and 17.5 µm wide. Cell wall covered by thin strokes. The species has been previously known from the Polar Urals (Voronikhin 1930).

Distribution: Europe, Asia, Australia, New Zealand, North America, South America.

Staurostrum bicornne Hauptfleisch, 1888

Figure 13

A single record in the Cherkaskul lake (UFU A 111). Cells 60.1 µm long and 47.3 µm wide without processes (with processes 82.2 µm wide), isthmus 13.9 µm wide. Semicells cup-shaped, fusiform when viewed from the top. The upper angles of cells extend into the hollow parallel processes with two spines at the ends. Cell wall on the top is covered by short spines and denticles. The species has been previously known from the Southern Urals (Snitko and Sergeeva 2003; Yarushina et al. 2004).

Distribution: Europe, Asia, Australia, New Zealand, North America.

Staurostrum lunatum Ralfs, 1848

Figure 14

The species is found in a small number in the Cherkaskul lake (UFU A 112). Cells 27.6–30.4 µm long and 32.6–32.8 µm wide, isthmus 13.5–13.7 µm wide. Semicells cup-shaped, triradiate when viewed from the top. The upper angles extended in diverging processes with one short spine on end. Cell wall is covered by small inconspicuous granules, arranged in concentric rows around angles. The species has been previously known from the Southern Urals (Snitko and Sergeeva 2003; Yarushina et al. 2004).

Distribution: Europe, Asia, Australia, North America, South America.

Staurostrum paradoxum Meyen ex Ralfs, 1848

Figure 15

The species is found in a small number in the Bolshoye Yamskoe lake (UFU A 99). Cells 15.5 µm long and 11.9 µm wide without processes (with processes 82.2 µm wide), isthmus 13.45 µm wide. Semicells cup-shaped, triradiate when viewed from the top. The upper angles elongate in diverging processes with three spines at the ends. Cell wall smooth. The species has been previously known from the Southern Urals (Snitko and Sergeeva 2003; Yarushina et al. 2004) and Polar (Sterlyagova 2008) Urals.

Distribution: Europe, Asia, Australia, New Zealand, North America, South America.

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